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The Response of the Dog to Test Doses of Riboflavin

BY
ALASTAIR N. WORDEN
Nutritional Research Unit, Huntingdon
AND
C. E. WATERHOUSE and R. N. PULMAN
Research Laboratories, Bob Martin Ltd., Southport

Introduction

IN a recent study of the effect of the oral administration of vitamin B_1 hydrochloride to dogs under controlled conditions of dietary intake, water consumption and environmental temperature (Worden, Waterhouse & Partington, 1955), it was found that there was a marked variation among individual animals in the response to test doses employed and that, particularly at the higher dosage levels, the urinary excretion of vitamin B_1 remained at an increased level for over 48 hours following dosage. Variations in urinary volume excreted per 24 hours were found to have a marked effect upon the vitamin excretion per 24 hours. It was concluded that a simple form of test dosage involving collection and examination of urine from the 24-hour period following dosage would not be adequate in establishing the nutritional status of the dog for this vitamin, but that observations over a much longer period would be required.

It was decided to extend these observations to the oral administration of riboflavin. The dietary intake and water consumption were controlled, and details of these are recorded. In this instance also, particular emphasis was laid on the importance of recording environmental temperature, in view of the known effect of this factor on the urinary excretion of riboflavin by the dog (Worden & Waterhouse, 1955).

Experimental

The observations were made on three dogs (two male, one female) and samples were collected as previously described (Worden, Waterhouse & Partington, 1952). Two of the dogs employed were used for the investigation of the response to test doses of vitamin B_1 hydrochloride (Worden *et al.*, 1955), and the same identification numbers have been retained.

For the determination of riboflavin in the urine, samples each containing approximately 15 μg. were acidified with 0.2 ml. hydrochloric acid (36 per cent. w/w HCl) and the mixture extracted with chloroform to remove extraneous soluble material. The aqueous layer was then treated by the procedure described by Kodicek & Wang (1949).

During the experiment each dog received measured quantities of a diet consisting of pressure-cooked

TABLE I.
DETAILS OF INDIVIDUAL DOGS AND THEIR DIETARY ALLOWANCES

Dog number and name	Breed	Sex	Date of Birth	Test number and date	Dietary allowance per 24 hours: Cooked rabbit meat (g).	Wholemeal bread (g.)	Milk (ml.)	Water (ml.)
4. "Scottie"	Scottish Terrier	Male	June 1950	(i) Feb., 1955	170*	128*	188*	500
				(ii) Mar., 1955	170*	128*	188*	500
7. "Roxy"	Cocker Spaniel; black and white	Female	April 1947	(i) Feb., 1955	170*	127*	187*	500
				(ii) May, 1955	170	128	187	500
8. "Jock"	Scottish Terrier	Male	June 1954	(i) Mar., 1955	170	128	188	500
				(ii) Apr., 1955	170	128	188	500

* On occasional days a proportion of the diet was left uneaten by the dog, and an appropriate allowance has been made for this in the calculations of daily intake.

rabbit meat, wholemeal bread and milk, and the quantities fed to each dog, together with other individual details, are given in Table I.

The riboflavin content of the homogenised diet was determined each day by the method of Kodicek & Wang (1949). The quantities of riboflavin administered to each dog, in addition to the normal dietary intake, during the various series of tests are shown in Tables II to IV. In each case, the riboflavin was administered in the form of a powder consisting of the appropriate quantity of riboflavin admixed with lactose as a base, and especial care was taken to ensure that the dog did, in fact, receive the complete dose. The quantities of riboflavin administered were designed to cover the range of dosage normally employed, based upon the published figures of requirement for optimum growth in the young dog (Potter, Axelrod & Elvehjem, 1942) and of the adult dog (Street & Cowgill, 1939).

Results

Dog No. 4—"Scottie"

In the first series in February, 1955, it will be seen that the lower dosage of 0.5 mg. riboflavin produced no significant response in the excretory level of this vitamin. This is due partly to the fact that the dog, at the beginning of this series, exhibited the erratic behaviour in the voiding of urine which has previously been commented upon. In fact, on three of the first four days, no sample was collected, whereas on the fifth and sixth days abnormally high volumes were collected. By the time the relatively high dose of 15 mg. was administered later in this series the dog was giving a daily sample, but again, on the day following dosage, the sample was much reduced, with a corresponding increase on the following day. The results for daily riboflavin output, therefore, illustrate very clearly the need to measure this for a much longer period than 24 hours following dosage. In this instance the very high output in the second 24-hour period was due partly to the increased volume of the sample on this day, and due also to a further rise in concentration per ml. The total increase in riboflavin excretion over the normal is, however, of the order of only 2 mg., compared with a dosage of 15 mg.

In the second series in March, 1955, dosage with 5 mg. riboflavin gave an increased urinary excretion over the normal of the order of 1.2 mg. It is interesting to note that again the maximum excretion occurred during the second 24-hour period following dosage, in spite of the fact that on this occasion the urinary volume per 24 hours remained relatively steady throughout the experiment.

Dog No. 7—"Roxy"

In the first series with this dog in February, 1955, there was great fluctuation in the volume of urine

TABLE II

THE DIETARY RIBOFLAVIN AND VITAMIN B_1 INTAKE, URINARY EXCRETION OF RIBOFLAVIN AND OTHER RESULTS FOR DOG NO. 4 HOUSED IN A METABOLISM CAGE AT STATED ENVIRONMENTAL TEMPERATURES

Dog number and name	Date	Riboflavin intake µg. per 24 hours	Vitamin B_1 intake µg. per 24 hours	Data on urinary samples collected at end of each 24 hours in metabolism cage				Temperature within metabolism cage (24-hour readings)	
				Volume of sample (ml.)	Specific gravity	Riboflavin		Minimum thermometer (°F.)	Maximum thermometer (°F.)
						µg. per ml.	µg. per 24 hours		
4. "Scottie"	14/2/55	480	151	—	—	—	—	—	—
	15/2/55	504	125	Nil	—	—	—	58	64
	16/2/55	408	113	360	1·023	0·84	302	50	62
	17/2/55	562	144	Nil	—	—	—	37	64
	18/2/55	515	151	590	1·032	0·85	502	50	58
	19/2/55	1,055 (a)	165	750	1·020	0·41	308	46	57
	20/2/55	225	58	362	1·008	0·24	87	48	58
	21/2/55	562	172	445	1·006	0·38	169	51	57
	22/2/55	658	158	380	1·022	0·74	281	54	56
	23/2/55	515	172	490	1·015	0·52	255	54	58
	24/2/55	15,562 (b)	158	460	1·051	0·58	267	52	60
	25/2/55	645	151	220	1·008	2·09	460	58	60
	26/2/55	528	172	720	1·014	2·72	1,960	56	57
	27/2/55	602	154	390	1·009	1·01	394	58	60
	28/2/55	782	192	380	0·996	0·54	205	56	60
	1/3/55	—	—	440	0·999	0·49	216	—	—
	24/3/55	706	158	—	—	—	—	—	—
	25/3/55	590	165	390	1·007	0·54	210	64	72
	26/3/55	576	158	570	1·007	0·45	256	72	78
	27/3/55	5,542 (c)	143	500	1·001	0·50	250	62	70
	28/3/55	596	144	440	1·003	1·58	695	62	70
	29/3/55	645	137	570	1·006	1·80	1,025	62	68
	30/3/55	520	158	430	1·008	0·79	340	64	70
	31/3/55	562	164	550	1·037	0·77	423	64	70
	1/4/55	—	—	370	1·009	0·66	244	62	70

(a) 500 µg. riboflavin administered 10 a.m. 19/2/55, in addition to riboflavin in diet.
(b) 15,000 µg. " " " 24/2/55, " " "
(c) 5,000 µg. " " " 27/3/55, " " "

voided daily, and in the initial three 24-hour periods the volumes were nil, 1,040 ml. and 300 ml. This behaviour renders the interpretation of the results obtained on a " per 24-hour " basis difficult and emphasises again the need to study excretory levels over an adequate period of time following dosage, and not to rely upon immediate " snap " samples covering only periods of relatively short duration. There was in this case a much smaller response to the high 15 mg. dosage, and it will be seen from Table III that although 1.49 mg. riboflavin was voided in the sample collected on February 11th, 1955, the previous day had yielded no sample and this figure must, therefore, be considered as the output for 48 hours.

In the second series in May, 1955, this dog gave a more regular sample during the test period and there was a marked rise in riboflavin excretion for the 24-hour period following dosage, the riboflavin concentration in the urine remaining at a high figure for this and the next two days. The increased output following the 5 mg. dose was, however, by no means as great as in the case of dog No. 4 (" Scottie "), this being similar to the situation observed in the case of the dosages during the first series with these two dogs. The much lower excretion following test doses in the case of this dog is of considerable nutritional significance in the light of the animal's subsequent history (" Roxy " gave birth to a litter of seven puppies on May 16th, 1955), and the particular demand for the vitamin may therefore be explained. On the assumption that " Roxy " actually absorbed into the tissues a quantity of riboflavin comparable with that absorbed and excreted by dog No. 4 (" Scottie "), then there appears to have been a high degree of retention and, therefore, utilisation of the riboflavin by this animal.

Dog No. 8—" Jock "

The experiments with this dog, and the results obtained therefrom, present a much less complicated picture, due principally to the fact that the animal gave a regular daily urine sample which did not fluctuate greatly as to volume and, in consequence, the riboflavin output per 24-hour period provides a better indication of the result of test doses. It has been our experience that the younger animal does tend to behave in this way. The subject of the " temperamental " suitability of certain animals, as compared with others, for nutritional work of this kind, has already been commented upon by us (Worden *et al.*, 1952).

In the first series in March, 1955, there was an indication of a small but definite increase in riboflavin output following the 0.5 mg. dose of the vitamin. The increased excretion following the high 15 mg. dose was, in this case, exceptional. It will be seen from Table IV that as much as 2.24 mg. was voided in the urine in the 24 hours following dosage, followed

TABLE III

THE DIETARY RIBOFLAVIN AND VITAMIN B_1 INTAKE, URINARY EXCRETION OF RIBOFLAVIN AND OTHER RESULTS FOR DOG NO. 7 HOUSED IN A METABOLISM CAGE AT STATED ENVIRONMENTAL TEMPERATURES

Dog number and name	Date	Riboflavin intake µg. per 24 hours	Vitamin B_1 intake µg. per 24 hours	Data on urinary samples collected at end of each 24 hours in metabolism cage				Temperature within metabolism cage (24-hour readings)	
				Volume of sample (ml.)	Specific gravity	Riboflavin µg. per ml.	Riboflavin µg. per 24 hours	Minimum thermometer (°F.)	Maximum thermometer (°F.)
7. " Roxy "	31/1/55	758	191	—	—	—	—	—	—
	1/2/55	489	234	Nil	—	—	—	64	68
	2/2/55	356	116	1,040	1·023	0·56	582	61	64
	3/2/55	665	191	300	1·005	0·66	198	64	75
	4/2/55	784 (a)	67	170	1·029	1·78	302	64	68
	5/2/55	241	61	470	1·013	1·22	574	64	68
	6/2/55	255	89	280	1·011	1·64	460	57	64
	7/2/55	656	164	392	1·016	1·94	760	54	61
	8/2/55	Nil	Nil	Nil	—	—	—	59	68
	9/2/55	15,752 (b)	157	424	1·015	1·34	568	64	68
	10/2/55	704	185	Nil	—	—	—	61	64
	11/2/55	628	160	500	1·016	2·98	1,490	57	64
	12/2/55	22	5	340	1·013	1·26	428	61	64
	13/2/55	—	—	300	1·013	2·78	835	59	72
	6/5/55	555	178	—	—	—	—	—	—
	7/5/55	555	171	Nil	—	—	—	70	72
	8/5/55	520	144	640	1·017	0·68	435	70	72
	9/5/55	692	158	280	1·019	0·92	258	72	72
	10/5/55	5,623 (c)	158	230	1·027	1·27	292	71	72
	11/5/55	520	164	280	1·031	3·03	848	70	72
	12/5/55	535	130	170	1·040	2·56	435	64	72
	13/5/55	514	158	190	1·029	2·00	380	72	74
	14/5/55	555	171	230	1·011	1·51	347	68	70
	15/5/55	548	178	170	1·014	1·49	253	68	70
	16/5/55	—	—	250	1·003	1·33	332	—	—

(a) 500 µg. riboflavin administered 10 a.m. 4/2/55, in addition to riboflavin in diet.
(b) 15,000 µg. " " " 9/2/55, " " "
(c) 5,000 µg. " " " 10/5/55, " " "

TABLE IV

THE DIETARY RIBOFLAVIN AND VITAMIN B_1 INTAKE, URINARY EXCRETION OF RIBOFLAVIN AND OTHER RESULTS FOR DOG NO. 8 HOUSED IN A METABOLISM CAGE AT STATED ENVIRONMENTAL TEMPERATURES

Dog number and name	Date	Riboflavin intake µg. per 24 hours	Vitamin B_1 intake µg. per 24 hours	Data on urinary samples collected at end of each 24 hours in metabolism cage				Temperature within metabolism cage (24-hour readings)	
				Volume of sample (ml.)	Specific gravity	Riboflavin µg. per ml.	Riboflavin µg. per 24 hours	Minimum thermometer (°F.)	Maximum thermometer (°F.)
8. "Jock"	7/3/55	700	178	—	—	—	—	—	—
	8/3/55	693	178	472	1·007	0·39	184	62	62
	9/3/55	638	158	580	1·005	0·42	244	62	64
	10/3/55	1,159 (a)	185	500	0·99[illegible]	0·48	240	60	64
	11/3/55	439	151	490	1·002	0·52	255	58	67
	12/3/55	535	151	450	1·006	0·67	302	62	64
	13/3/55	577	165	540	1·014	0·56	302	60	66
	14/3/55	432	123	520	1·019	0·77	400	62	66
	15/3/55	15,480 (b)	172	495	1·017	0·65	322	64	69
	16/3/55	686	185	540	1·018	4·07	2,240	66	72
	17/3/55	590	172	422	1·01[illegible]	2·25	950	64	70
	18/3/55	672	165	590	1·028	1·02	602	63	70
	19/3/55	—	—	392	1·019	1·26	494	63	68
	20/4/55	590	151	—	—	—	—	—	—
	21/4/55	582	158	420	1·004	0·26	109	42	78
	22/4/55	596	151	390	1·014	0·38	148	50	80
	23/4/55	5,548 (c)	178	476	1.002	0·57	268	50	80
	24/4/55	706	178	470	1·009	2·03	955	48	80
	25/4/55	528	165	380	1·009	2·35	892	48	60
	26/4/55	562	151	586	0·998	1·08	626	48	74
	27/4/55	672	254	520	1·009	0·83	432	50	68
	28 4 55	—	—	390	1·006	0·91	355	50	68

(a) 500 µg. riboflavin administered 10 a.m. 10/3/55, in addition to riboflavin in diet.
(b) 15,000 µg. " " " 15/3/55, " " "
(c) 5,000 µg. " " " 23/4/55, " " "

by 0.95 mg. and 0.60 mg. respectively in the subsequent 24-hour periods. In the four days following the high dosage, a quantity of the order of 3 mg. of the vitamin, over and above that normally present in the standard diet employed, was voided in the urine. This compares with the figure of 2 mg. voided by dog No. 4 ("Scottie") following this dose.

In the second series in April, 1955, there was again a pronounced response to the dosage with 5 mg. riboflavin. It is interesting to note that not only did "Jock" excrete a quantity of the order of 2 mg. in excess of normal following this dosage, but that he excreted this quantity over a period of at least four days following dosage.

Discussion

It has been reported that in cases of riboflavin deficiency the measurement of the daily output of riboflavin is unreliable, since it is only a measure of the immediate dietary intake. Najjar & Holt (1941) suggested that the response to a test dose of pure riboflavin would be a more satisfactory method of assessing nutritional status, using a technique similar to that employed for vitamin B_1. They found that, following intravenous injection of 1 mg. riboflavin, the urinary excretion at half-hourly intervals following dosage was related to the degree of deficiency of the vitamin.

Certain workers have reported that following test doses to adequately nourished subjects, there was a high urinary excretion. For example, Swaminathan (1942) found that with doses of 1 to 19 mg. as much as 80 per cent. of the dose was excreted in the urine within 24 hours. Others have found much lower recoveries following the test dose procedure. Keys, Henschell, Mickelson, Brozek & Crawford (1944), using young men on a diet yielding slightly suboptimal amounts of riboflavin (0.31 mg. per 1,000 Cals.), obtained a recovery of only 12 per cent. in the urine following a 1 mg. test dose.

As in the case of vitamin B_1 hydrochloride, however, the value of the procedure in the case of riboflavin has also been criticised. Axelrod, Spies, Elvehjem & Axelrod (1941) claimed that the test dose method was unsatisfactory as a means of assessing nutritional status. Following doses of 200 and 4000 µg. riboflavin per kg. bodyweight to several human subjects, they found no correlation between the percentage of test dose retained as against the amount excreted in the urine. This was confirmed by Hagedorn, Kyhos, Germek & Sevringhaus (1945) who, in studies on a group of adult males, showed that after administration of riboflavin supplements in the form of tablets, or of food rich in vitamins, there was an increase of vitamin excretion in the urine. The retention of riboflavin from such supplements varied from 17 to 80 per cent., with no apparent reason for the wide fluctuations.

The urinary excretion of riboflavin by other mammals has been studied less extensively. It has been reported that in experiments with dogs and rats (Fraser, Topping & Isbell, 1940), the riboflavin-deficient animals excreted less of the vitamin in the

urine than did animals receiving a normal diet, and that the fall in excretory level was observed before the clinical signs of riboflavin deficiency appeared.

The daily urinary excretion of riboflavin by adult bitches of various bodyweights was studied by Beher & Gaebler (1950), who found that excretion of the vitamin was different for individual animals receiving similar amounts of the same diet. The administration of testosterone propionate to a given bitch lowered the amount of riboflavin excreted, due, presumably, to the anabolic effects of the male hormone.

While the degree of utilisation of riboflavin must be influenced by the metabolic rate, which affects the proportion appearing in the urine, it is reasonable to assume that the requirement of the animal will depend mainly on the nutrients which are utilised. For this reason it may be expected that in a colder environment—where the calorific demands are increased—there will be an increase in the utilisation of riboflavin. In an experiment with young pigs, Mitchell, Johnson, Hamilton & Haines (1950) showed that riboflavin requirements were inversely related to environmental temperature, being 1.2 p.p.m. in the ration at 85° F. and 2.3 p.p.m. at 42° F. These values were equivalent to 0.54 and 1.04 mg. riboflavin per lb. feed at the high and low environmental temperatures respectively. This difference was confirmed in preliminary experiments with older pigs.

A similar effect has also been observed in dogs (Worden & Waterhouse, 1955), in which it has been shown that with an increase of 20° F. in the environmental temperature the total daily urinary excretion of riboflavin in two dogs was 75 per cent., and in a third dog about 25 per cent., greater at the higher environmental temperature.

The urinary excretion of riboflavin on a given intake of the vitamin may be related not only to the diet, but also to the degree of physical activity. Mickelson, Doeden & Keys (1945) showed that men who were excreting 0.64 mg. riboflavin daily excreted 1.07 mg. daily during a period of bed rest, and this figure returned to normal on resuming normal activities.

A correlation between riboflavin excretion and nitrogen balance was observed by Oldham, Loundes & Porter (1947), who found that in human beings on a controlled dietary intake the percentage riboflavin excreted when the subjects were in negative nitrogen balance varied from 40 to 60 per cent., whereas when in positive nitrogen balance only 7 per cent. of a similar intake was excreted.

When employing the test dose method for riboflavin, the possibility of failure to absorb the whole of the dose must be considered. The quantities of the vitamin excreted in the urine in the case of dog No. 8 ("Jock") did show, however, that a considerable proportion must have been absorbed. A determination of the riboflavin content of the faeces—which would, presumably, contain unabsorbed vitamin—does not, unfortunately, give information on this point. It has been shown in man that the excretion of riboflavin in the faeces varies considerably in different individuals, although it is remarkably constant in any one individual (Davis, Oldham & Roberts, 1946). This is due, presumably, to the fact that riboflavin—like vitamin B_1—may be synthesised by the intestinal organisms.

The relatively small proportion of riboflavin excreted by dog No. 7 ("Roxy") as compared with the other dogs, following a similar test dose, may be related to the increased nutritional demands during the gestation period. It has been shown that women, during pregnancy, excrete less riboflavin in the urine than normally, even when large doses (5 mg.) are injected intravenously (Dubrauszky & Blazso, 1943).

The special factors which arise in experiments designed to test the response of the dog to the administration of test doses of vitamins, and which may not arise in experiments with human patients, were discussed in a previous paper (Worden *et al.*, 1955). Our observations have indicated that when the test dose procedure is employed to assess nutritional status, the observations must be made over a period of several days. The increased excretion of riboflavin following a test dose has been shown to persist for periods of four to five days following dosage, a time in excess even of that previously reported in the case of vitamin B_1. In the light of our findings it would appear to be useless in the case of dogs to base any observations upon the amount excreted in a period of 24 hours or less, a procedure which has been adopted with human subjects. That the test dose procedure may, in fact, yield positive and useful evidence on the subject of a dog's nutritional status as regards riboflavin, has been borne out by the results obtained with dog No. 7 ("Roxy"). It would not seem possible, however, to lay down criteria for the evaluation of riboflavin status upon the simple basis of the proportion of the test dose that is excreted within a limited period.

Summary

1. Two dogs and one bitch have been maintained in a metabolism cage on a standard diet and a standard water intake. The response of these animals to test doses of riboflavin, varying from 0.5 mg. to 15 mg., has been studied.

2. There was some individual variation in the response to these test doses, particularly in the higher dose ranges. In the case of the lower dosage of 0.5 mg. there was a definite indication of an increased urinary output of riboflavin in only one of the three animals.

3. Especially at the higher dose levels, the urinary level of riboflavin was significantly increased for a period as long as four days or more after the test dose. The maximum excretion often occurred in the second 24-hour period following dosage.

4. In the bitch in whelp it has been noted that during the gestation period the urinary output of riboflavin, following a relatively high test dose, was negligible compared with that of male dogs under similar dietary conditions.

5. These studies indicate that a simple form of test dosage would not be of value in clinical practice in establishing the riboflavin status of dogs: observations under carefully controlled environmental conditions, and extending over several days, are necessary to assess the effect of a test dose.

Abortion in two Cats, with the isolation of *Salmonella cholera suis* from one case

BY

LIONEL A. HEMSLEY

Cambridge

ABORTION in the cat is rare in the experience of Kirk (1954), while Bloom (1954) suggests that organisms which may be causative are chiefly streptococci. In the cases described below a coliform and *Salmonella cholera suis* were isolated; the presence of the latter is of some curiosity.

Case 1

Subject.—A shorthair tortoiseshell female, 15 months old, which had had one previous parturition. This was a town cat from Glamorganshire.

History.—The cat had come home two days previously listless and unwilling to walk. Appearance had been normal previously.

Case book details as entered were:—

1:2:55.—Good condition, dull. Pulse 160. Temperature 102.1°. Breath slightly unpleasant smell. Did not resent abdominal palpation. Blood-stained vaginal discharge, urine bloodstained. Treatment, parenteral penicillin administered.

2:2:55.—Very depressed. Temperature 101.5°. Euthanasia performed.

Post-mortem examination.—There was no evidence of abdominal bruising. The uterus contained a decomposing foetus, hairless, of about 5 cm. long. The urine was clear in the bladder. There was liver centilobular congestion, while the other organs appeared normal.

Bacteriological examination of swabs, taken with aseptic precautions from the uterus showed:—*Smear*,—fairly heavy mixed flora, including gram-negative rods and gram-positive cocci both singly and in very short chains. *Cultures:* aerobic—pure, heavy culture of a haemolytic coliform bacillus.

Case 2

Subject.—A shorthair tortoiseshell female, eight to nine years old. A country cottager's cat from Worcestershire.

History.—Last seen 11 days ago when appeared normal. Was assumed to have been killed, but returned home this morning.

Case book details as entered were:—

12:7:55.—Emaciated, dull, only just able to walk. Vomiting. Temperature 101.6°. Eyes sunken. Very pale mucous membranes. Vaginal discharge, with blowfly eggs adhering. Euthanasia performed.

Post-mortem examination.—The uterus contained three foetuses, about 7 mm. in length, a little fresh blood, and some thick pink matter. The heart was flabby; liver and kidneys appeared pale and yellowish. The stomach contained watery milk and grass; there was no evidence of inflammation. The urine was thick, but produced no precipitate on mixing with sulphosalycylic acid.

Bacteriological examination of swabs, taken with aseptic precautions from the uterus showed:—

Culture: a salmonella was isolated, with the following antigenic structure:—o = 6, 7 H = C – 1, 5. It was, therefore, *Salmonella cholera suis* (American type).

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References

AXELROD, A. E., SPIES, T. D., ELVEHJEM, C. A., & AXELROD, V. (1941). *J. clin. Invest.* **20.** 229.

BEHER, W. T., & GAEBLER, O. H. (1950). *J. Nutr.* **41.** 447.

DAVIS, M. V., OLDHAM, H. G., & ROBERTS, L. J. (1946). *Ibid.* **32.** 143.

DUBRAUSZKY, V., & BLAZSO, S. (1943). *Z. Vitaminforsch.* **14.** 2, 13.

FRASER, H. F., TOPPING, N. H., & ISBELL, H. (1940). *U.S. Publ. Health Rep.* **55.** 280.

HAGEDORN, D. R., KYHOS, E. D., GERMEK, O. A., & SEVRINGHAUS, E. L. (1945). *J. Nutr.* **29.** 179.

KEYS, A., HENSCHELL, A. F., MICKELSON, O., BROZEK, J., & CRAWFORD, J. H. (1944). *Ibid.* **27.** 165.

KODICEK, E., & WANG, Y. L. (1949). *Biochem. J.* **44.** 340.

MICKELSON, O., DOEDEN, D., & KEYS, A. (1945). *Fed. Proc.* **4.** No. 1, 98.

MITCHELL, H. H., JOHNSON, B. C., HAMILTON, T. S., & HAINES, W. T. (1950). *J. Nutr.* **41.** 317.

NAJJAR, V. A., & HOLT, L. E. (1941). *Johns Hopkins Hosp. Bull.* **69.** 479.

OLDHAM, H., LOUNDES, E., & PORTER, T. (1947). *J. Nutr.* **34.** 69.

POTTER, R. L., AXELROD, A. E., & ELVEHJEM, C. A. (1942). *Ibid.* **24.** 449.

STREET, H. R., & COWGILL, G. R. (1939). *Amer. J. Physiol.* **125.** 323.

SWAMINATHAN, M. (1942). *Indian J. Med. Res.* **30.** 37.

WORDEN, A. N., & WATERHOUSE, C. E. (1955). *Brit. J. Nutr.* **9.** 5.

———, ———, & PARTINGTON, H. (1952). *Vet. Rec.* **64.** 836.

———, ———, & ———. (1955). *Ibid.* **67.** 503.

BLOOM, F. (1954). "Pathology of the Dog and Cat." Page 376. American Veterinary Publications, Evanston.

KIRK, H. (1954). "Index of Treatment." 3rd edition. Page 193. Baillière, Tindall & Cox, London.

THE VETERINARY RECORD March 10th, 1956.

74th ANNUAL CONGRESS AT LEAMINGTON SPA, 16th to 22nd SEPTEMBER

We publish below advance details of the Congress programme in order that members of the Association may have an approximate idea of the professional, scientific and social arrangements for the week, before reserving hotel accommodation. May we emphasise again the need to make hotel bookings at the earliest opportunity. Those hotels which still have accommodation available are listed overleaf.

SUNDAY, 16th SEPTEMBER
Evening: 'At Home' given by the Midland Counties Division.

MONDAY, 17th SEPTEMBER
Morning: Opening of Congress by the Duke of Devonshire, M.C.
Opening of Exhibition by the President.
Afternoon: "Review of Present Knowledge of Johne's Disease" by T. M. Doyle, F.R.C.V.S., D.V.S.".
Evening: Civic Reception and Dance at the Town Hall.

TUESDAY, 18th SEPTEMBER
Morning: "Farm Health Problems: Where Does Britain Stand Today?"
Afternoon: Demonstrations.
Evening: Ladies' Guild Dance at the Spa Ballroom, Leamington.

WEDNESDAY, 19th SEPTEMBER
Morning: "Present-day Toxicity Problems: A Review" by J. D. McGirr, B.Sc., M.R.C.V.S.
"Cage Birds as Patients in Private Practice" by Dr. T. Hare, Ch.B., B.V.Sc., M.R.C.V.S.
Afternoon: Annual General Meeting, with Presidential Address.
Evening: Annual Banquet at the Leofric Hotel, Coventry.

THURSDAY, 20th SEPTEMBER
Morning: "The Anatomy of Disc Protrusion in the Dog" by Dr. A. S. King, B.Sc., M.R.C.V.S.
"Artificial Insemination in Pigs" by C. Polge, B.Sc., and L. E. A. Rowson, O.B.E., M.R.C.V.S.
"Foot-rot in Sheep" by Professor W. I. B. Beveridge, D.V.Sc., M.A.
Afternoon: Free
Evening: Free, or visit to Shakespeare Theatre. Please make application immediately to B.V.A. Headquarters.

FRIDAY, 21st SEPTEMBER
Morning: "Animal Diseases from the Point of View of Human Medicine" by Dr. P. G. Arblaster, M.R.C.P. and Dr. A. P. Prior.
"Examination of the Eye with Special Reference to the Horse and Dog" by Professor C. Formston, F.R.C.V.S.
Afternoon: "Poultry Breeding for Increased Production with Special Reference to Health" by J. O. I. King, B.Sc., M.V.Sc., M.R.C.V.S.
Evening: President's Reception and Dance at Chesford Grange.

SATURDAY, 22nd SEPTEMBER
Morning: Closing Meeting of Congress.

HOTELS IN LEAMINGTON SPA

	Bed and Breakfast £ s d		Bed and Breakfast £ s d.
Regent Hotel*	1. 1.0	Crown Hotel	19.6.
Spa Hotel*	1. 1.0	Marlborough Hotel	19.6.
Oaks Hotel	1. 1.0	Chesford Grange (3 miles)	1. 5.6.

Private Hotels:-

Angel, 145 Regent Street	16.9	Alkerton, Binswood Avenue	17.6
Amersham, Kenilworth Road	17.6	Arden, Clarendon Square	18.6
Armathwaite, Kenilworth Rd.	1. 1.0	Bankfield, Newbold Terrace	17.6
Roselands, Binswood Avenue	17.6	Sheiling, Beauchamp Avenue	1. 1.0
		Westella, Leam Terrace	15.0

HOTELS OUTSIDE LEAMINGTON SPA

Woolpack, Warwick (2 mls)	17.6	Abbey, Kenilworth (5 mls)	1. 1.0
Lord Leycester, Warwick (2 miles)	1. 1.0	Queen & Castle, Kenilworth (5 miles)	16.6
Leofric Hotel, Coventry (9 miles)	1.17.6	Rouncil Towers, Motel, Kenilworth (5 mls)	1. 8.6
Glebe Hotel (Private) Barford (4 miles)	1. 1.0	Falcon Hotel, Stratford (10 miles)	1. 5.0
King's Head, Wellesbourne (6 miles)	17.6	Red House Hotel, Stratford (10 miles)	1. 5.0
Ettington Park, Ettington, Warwick (12 miles)	1. 1.0	Welcombe Hotel, Stratford (10 miles)	2. 5.0
		Craven Arms, Southam (7 mls)	16.0

* These hotels have vacancies for some nights during Congress week.

NEWS AND COMMENT

Area Eradication Plan for Tuberculosis

The Minister of Agriculture has announced his intention to provide free tuberculin tests of cattle, commencing March 1st, 1956, in the following two areas which it is intended to declare as Tuberculosis Eradication Areas in two years' time: a) The counties of Kent and East Sussex; b) The counties of Dorset, Somerset and Wilts., and part of the county of Devon.

The Secretary of State for Scotland has announced his intention to provide free tuberculin tests of cattle, commencing March 1st, 1956, in the following two areas, which it is intended to declare as Tuberculosis Eradication Areas in two years' time: a) The counties of East Lothian, Roxburgh and Berwick; b) Parts of the counties of Perth, Moray and Banff.

NEWS AND COMMENT

Producing The Record

Once again, all we are able to offer our readers is a sadly attenuated issue, the third of its kind in succession. By the time these words are read the Industrial Court which has been examining the printing dispute will have made its recommendations, and it is earnestly to be hoped they will commend themselves to both sides. In the meantime, we can only express our regret to authors and other contributors whose work is delayed in publication.

Part of Headquarters remains constantly a minor hell of black duplicating ink, odourous benzine and noise. Worse still, the finger nails (but happily not the tempers) of the General Secretary's, and the Editor's lady staff continue to be ravaged in our readers' interes

A.R.C. Veterinary Research Fellowships

The Agricultural Research Council is offering two veterinary research fellowships to provide opportunities for suitably qualified veterinarians to undertake research. The Fellowships are tenable for a maximum of three years and carry a stipend of £850 a year, plus superannuation. The value of the awards is, however, under review. Candidates must be British subjects and hold a registrable veterinary qualification, and should have been engaged in research for not less than three years since qualifying.

The Council is also continuing to offer post-graduate research studentships and training grants to holders of veterinary qualifications, and a small number of veterinary training grants to enable honours graduates in one of the basic sciences to read for a veterinary qualification after taking their science degree. Application for these awards should reach the Council by the 24th March.

Further details of all these awards, together with information about openings in agricultural research and advisory work, are obtainable from the Secretary, Agricultural Research Council, Cunard Building, 15 Regent Street, London, S.W.1.

Liverpool University Veterinary Society Ball

The annual ball of this Society was held in the Students' Union on March 2nd. Among the guests, including members of the staff, was the President of the Royal College with Mrs. Sumner.

The M.C. was Mr. J. G. Hamilton, of third year, and the decorations, catering and business arrangements were in the hands of Messrs. P.A.S. Davidson, J.F. Hamilton and R. H. Haywood, of the third year, assisted by fellow year members.

Foundation-Stone Laying for New Research Station

The foundation stone for the new farm livestock research station of the Animal Health Trust was laid at Stock, Essex, by the Duke of Norfolk, President of the Trust, on March 1st.

The station is being built by the Trustees of the Boreham Institute of Agricultural Engineering. The first stage of the new laboratories is at present under construction together with the necessary animal houses and other subsidiary buildings, at a cost of £60,000. Another wing will be added later. It is expected that the station will be in operation by the summer.

Among those present at the ceremony, which took place in grounds adjacent to Lilystone Hall which will house part of the research station, were the President of the Royal College of Veterinary Surgeons, the Lord Lieutenant, Sir William Slater, and Professor W. I. B. Beveridge.

In a brief speech the Duke of Norfolk recalled the generous arrangements made by the Boreham Institute, (as described previously in these columns) and said that the Trust looked with confidence to the agricultural and allied industries to support the station with adequate finance. He read a message from Lord Perry, and expressed the Trust's very grateful thanks to him and to the other trustees of the Institute.

Dr. W. R. Wooldridge, as Scientific Director of the Trust, thanked the Duke for this and many other instances of practical help. The staff of the new station were looking forward not only to their basic research work but to collaborating with the veterinary surgeons and farmers in that and other parts of the country.

CORRESPONDENCE

The Growth of Free Clinics

Sir, - May I be allowed to question the right, moral, legal or otherwise, by which a powerful charity is allowed to open a free clinic almost next door to a veterinarian's surgery? Without any previous consultation or subsequent co-operation it then proceeds to compete on grossly unequal terms with a practice built up by ten years' hard work.

Yours faithfully,

PETER O. RANDLE

164, Grove Street,
Liverpool, 7.

March 2nd, 1956.

COMING EVENTS

March

15th (Thurs.) General Meeting of the South Eastern Division, B.V.A. at the Royal Star Hotel, Maidstone at 2.30 p.m.
Informal Dance of the Yorkshire Division, B.V.A. at Parkway Hotel, Bramhope, Leeds. Tickets: Mr. A.J. Adams, 485, Bradford Road, Thornbury, Bradford.
16th (Fri.) The V.V.B.F. Ladies' Guild Dance at the Luncheon Club, Ministry of Agriculture, Tolworth, 8 p.m.
General Meeting of the Lincolnshire & District Division, B.V.A. at the George Hotel, Grantham, at 2.15 p.m.
21st (Wed.) Laboratory Meeting of the Section of Comparative Medicine, R.S.M., in the National Institute for Medical Research, The Ridgeway, Mill Hill, N.W.7.
Ordinary General Meeting of the Sussex Division, B.V.A. in the Old Ship Hotel, Brighton, 2.30 p.m.
22nd (Thurs.) Spring Meeting of the North of Scotland Division, B.V.A. at the Northern Hotel, Aberdeen, 2.30 p.m.
27th (Tues.) General Meeting of the Society of Practising Veterinary Surgeons, B.V.A. at the Department of Veterinary Surgery, Langford, 2.15 p.m.
29th (Thurs.) Meeting of the Essex Division, B.V.A. in the Dept. of Veterinary Clinical Studies, Cambridge, 2.30 p.m.

April

4th, 5th & 6th. B.V.A. Council and Committee Meetings at Royal (Dick) School of Veterinary Studies, Edinburgh.
6th (Fri.) Meeting of the North Wales Division, B.V.A., Ruthin 2.0.
7th (Sat.) 10th Annual Dinner of the B.R.X. Club at the Royal Veterinary College, 6 p.m.
20th (Fri.) Meeting of the Mid-West Division, B.V.A.
26th (Thurs.) Meeting of the Essex Division, B.V.A. in the Essex Institute of Agriculture, Writtle, Essex, 7.30 p.m.

May

4th (Fri.) Annual Ball of the Royal Veterinary College Students' Union Society at the Criterion Restaurant, 9 p.m. Tickets: £3.3.0. each from the Social Secretary.
16th (Wed.) A.G.M. of the Scottish Regional Group of the A.V.T. & R.W's in the University of Glasgow Veterinary Hospital, Bearsden Road, Bearsden, 2.15 p.m.

PERSONAL

Birth

ANGUS. - On February 16th, 1956, to Jean, wife of C.E. Angus, M.R.C.V.S., at Gors Home, Anglesey, a daughter, Margaret Janet, sister for James.

APPOINTMENTS VACANT

£750 - £800, regular leisure, reasonable use of car, offered to keen young practitioner in return for assistance in Midlands mixed practice. Interview essential, expenses paid. Apply with reference to Box 208.

Capable married assistant needed. Must be experienced all branches Regular leisure, etc. Practice in S.E. England. Good salary paid.- Box 214.

Assistant required in small animal practice near London. Self contained flat available.- Matthews, 56, Pembroke Road, Ruislip, Middlesex.

Male or female assistant of experience wanted for small-animal side of general practice in East Anglia. Send full particulars.- Box 220.

Locum wanted for small-animal practice May to June.- Box 221.

Experienced assistant wanted in general practice, mainly agricultural, good prospects for suitable man. Write fully.- Box 222.

Capable assistant required in agricultural practice, West Devon. Salary £750 - £1100 p.a. plus usual perquisites, according to experience. Car supplied if necessary. Car supplied if necessary. Full details and references in first instance to Box 223.

Single male assistant required in mixed practice, Herefordshire. Interview expenses paid.- John N. Peatt, Leominster 2266.

Assistant, few months for general practice. Apply Clouston, Lerwick, Shetland. Telephone GOTT 226.

Experienced assistant, preferably L.V.I. required. Large animal practice. South Midlands. £700 - £750 according to capabilities, plus percentage. References essential to Box 227.

Temporary assistant required in small-animal practice, London area, commencing end of April.- Box 198.

Single assistant required in a mixed practice in the East Midlands. Recent graduate would suit. Regular leisure with use of car. Minimum salary £730 with regular increases.- Box 229.

Locum required small-animal practice March 29th-April 8th inclusive. Own car.- Box 236.

Married assistant, with at least two years' experience, required in good class agricultural practice, Wiltshire. Unfurnished accommodation available. Salary £700-£1,000 according to experience. Permanency for right man.- Box 237.

Assistant required in busy agricultural practice. Excellent salary for suitable applicant. Usual amenities. - Blanshard, Tel: Gillingham (Dorset) 47.

Married assistant required for mixed agricultural practice in North-West. Eligible L.V.I. Salary according to experience with free flat and use of car.- Box 239.